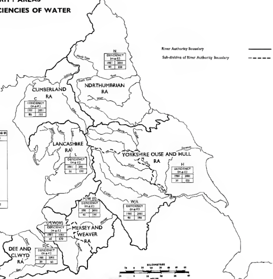
NORTH OF ENGLAND

Fig. 1

RIVER AUTHORITY AREAS AND ESTIMATED DEFICIENCIES OF WATER

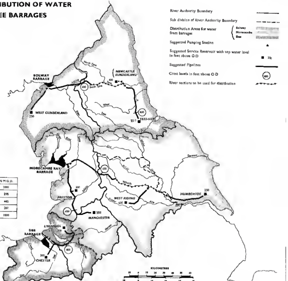
RIVER AUTHORITY (OR SUB-DIVISION)		DEFICIENCY IN M.G.D.	
		1981	2001
CUMBERLAND	C	55	110
NORTHUMBRIAN	N	90	235
N. and E. RIDING (Including Humberside)	H	30	155
W. R. DING	W/R	60	180
LANCASHIRE	L	50	130
MERSEY and WEAVER (W)	M/W	65	170
MERSEY and WEAVER (E)	M/W	45	140
DEE AND CLWYD	D/C	30	80
TOTALS		425	1200



NORTH OF ENGLAND

Fig II

A POSSIBLE DISTRIBUTION OF WATER FROM THREE BARRAGES



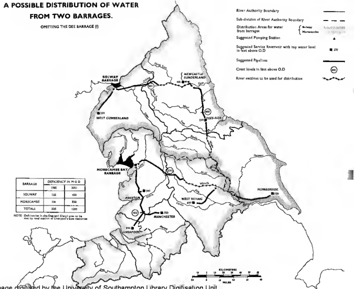
BARRAGE	DEFICIENCY IN M.G.D.	
	1981	2001
SOLWAY	95	295
MORECAMBE	35	445
DEE	95	260
TOTALS	225	1000

NORTH OF ENGLAND

Fig. III

A POSSIBLE DISTRIBUTION OF WATER FROM TWO BARRAGES.

OMITTING THE DEE BARRAGE (I)



BARRAGE	DEFICIENCY IN M G D	
	1981	2001
SOLWAY	125	650
MORECAMBE	100	550
TOTALS	225	1200

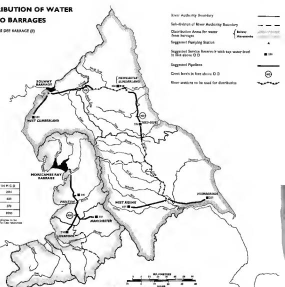
NOTE Deficiencies in the Dee and Clwyd area to be met by reallocation of Liverpool's Dee resources

NORTH OF ENGLAND

A POSSIBLE DISTRIBUTION OF WATER FROM TWO BARRAGES

OMITTING THE DEE BARRAGE (II)

Fig. IV



BARRAGE	DEFICIENCY IN M G D	
	1981	2001
SOLWAY	185	630
MORECAMBE	40	370
TOTALS	225	1000

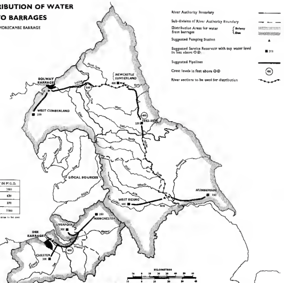
NOTE: Deficiencies in the Dee and Clwyd area to be met by re-allocation of Liverpool's Dee resources

NORTH OF ENGLAND

Fig. V

A POSSIBLE DISTRIBUTION OF WATER FROM TWO BARRAGES

OMITTING THE MORECAMBE BARRAGE



BARRAGE	DEFICIENCY IN M.G.D.	
	1981	2001
SOLWAY	135	630
DEE	90	370
TOTALS	225	1000

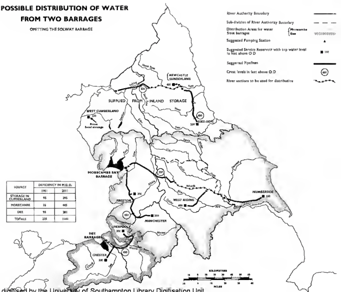
NOTE: Deficiencies in the Lancashire area to be met from local sources

NORTH OF ENGLAND

Fig. VI

A POSSIBLE DISTRIBUTION OF WATER FROM TWO BARRAGES

OMITTING THE SOLWAY BARRAGE



SOURCE	DEFICIENCY IN M.G.D.	
	1981	2001
STORAGE IN CUMBERLAND	95	295
MORECAMBE	35	445
DEE	95	260
TOTALS	225	1000

Introduction

1. In March 1965 we were asked by the Minister of Land and Natural Resources to take charge of studies to determine the feasibility and probable cost of constructing barrages across Morecambe Bay and the Solway Firth and what quantity and quality of water each of these two schemes might make available. In view of the responsibility of the Secretary of State for Scotland for water resources and regional development in Scotland, it was agreed that the Scottish Office should work jointly with us on the Solway project. When announcing their intention to proceed with these studies the Government stated that the justification for a barrage across Morecambe Bay or Solway Firth "would rest primarily on the conservation of water on a scale large enough to meet the long term needs of north west England and south west Scotland". The announcement went on to say that "advantages for communications, power generation and amenity would arise but these would be subsidiary". It should be understood that this report refers only to the water supply potential of the proposed barrages and does not deal with those matters which the Government referred to as being subsidiary. Precise terms of reference for our studies were subsequently agreed with the Minister of Land and Natural Resources and the Secretary of State for Scotland. These are set out in full in Appendix A to this report.

2. It was our intention that comprehensive investigations of the physical feasibility and probable costs of barrages and the yields and qualities of water which would be made available should be remitted to consulting engineers and by the beginning of July 1965 detailed programmes of work extending over a period of three years had been agreed with Sir Alexander Gibb & Partners and Messrs. Babtie, Shaw and Morton for Morecambe Bay and Solway respectively. In the light of the Chancellor of the Exchequer's statement in Parliament on 27th July on the deferment of capital projects, however, it was not possible to make an immediate start on these investigations. Instead, approval was given for preliminary studies of both schemes, based upon such documentary and other records as were available to determine:

(1) the quantity of water which can be made available;

(2) the problems associated with making that water potable;

(3) the probable cost of making that water potable.

Sir Alexander Gibb and Partners and Messrs. Babtie, Shaw and Morton agreed to undertake these studies and subsequently worked closely with each other in the course of them. We think it right to place on record at the outset our appreciation of their work and the manner in which the results of that work have been presented to us.

The Desk studies

3. In accordance with undertakings given in Parliament both studies are being published by Her Majesty's Stationery Office. Each of them contains a summary of conclusions which for convenience are set out in Appendices B and C to this report.

Comments on the desk studies

4. It must be stressed that these reports do not unreservedly establish the feasibility of the barrage schemes and are in no sense an adequate substitute for the full investigations referred to in paragraph 1 on the previous page. Indeed, this point is stressed by the consultants in their reports. Much more work needs to be done on the engineering problems of construction, water treatment and, not least, on the effects of barrages on other interests before firm decisions can be reached.

Yields and water quality

5. At both Morecambe Bay and Solway the available hydrological information is scanty, and in neither case have the consultants been able to make use of run-off records for the catchment concerned. Nevertheless there is no reason at present to doubt that yields of the order suggested by the consultants can be obtained. Neither study suggests that there will be serious difficulty in treating water impounded in this way, but further work will be needed before firm conclusions can be reached. The problem of initial salinity is not dealt with in detail in the reports and cannot be until further investigations have been made, although there is no reason to anticipate any insurmountable difficulties in this connection.

Construction problems

6. Both consultants describe interesting methods of construction to deal with the problems associated with final closure of a tidal basin. However, both also stress that more detailed site surveys, exploratory boring and model investigations will be necessary before they can assure themselves of the validity of their present assumptions.

Effects on other interests

7. Because the desk studies were confined to available documentary and other existing information, the consultants were not in a position to carry out detailed investigations of the probable effect of a barrage on the natural ecology of the area and on a variety of other interests including land drainage, navigation, fisheries and amenity. Determination of the effect of these interests is absolutely fundamental and provision for it was included in our full terms of references. We cannot overstress the importance of this. The precise effect, if any, of barrages on siltation to seaward of them and the consequences for ports in the vicinity must be determined. Similarly, experimental work is necessary to show whether or not it will be possible with the aid of fish passes to maintain the runs of migratory fish into such rivers as the Eden.

Use of water from Morecambe Bay and Solway

Future demands

8. Because of the large quantity of water made available a study of a barrage scheme as a water conservation project must include an examination of the demands which it can be expected to meet, the arrangements necessary to distribute barrage water, the delivered cost of water and comparison with other possible sources in

relation to those demands. These items were, of course, included in our full terms of reference. To investigate them we have obtained the help of the six river authorities and the corresponding area committees of the British Waterworks Association in the north of England. We have set up a Technical Working Party comprising representatives from those authorities and committees together with members nominated by the Central Electricity Generating Board and the British Waterways Board. In effect this Working Party is making a regional study of water resources over the whole of the areas of the Northumbrian, Yorkshire Ouse and Hull, Dee and Clwyd, Mersey and Weaver, Lancashire and Cumberland river authorities. A comparable study in South West Scotland is not being undertaken because the Scottish Development Department have stated that future demands there to meet the needs of natural growth are likely to be met other than from a Solway barrage. However, if a programme of planned growth were undertaken in the Solway region the situation might be different and would need further review.

9. The data so far assembled by the Working Party cover the future demands of statutory water undertakings for the populations within each of those river authority areas. A start has also been made on assembling figures of present industrial demand and applying an estimated growth rate for future needs. Further work will be required before firm figures can be given. On the basis of the information so far available, however, we have tried to assess future net deficiencies. These are shown in Table 1. Column (b) may be assumed to cover agriculture also.

TABLE 1

Net deficiencies (m.g.d.) in river authority areas

River Authority	1981			2001		
	(a) Public water supply	(b) Other	(c) Total (a) + (b)	(d) Public water supply	(e) Other	(f) Total (d) + (e)
1. Northumbrian	80	10	90	205	30	235
2. Yorkshire Ouse & Hull	70**	20	90	285***	50	335
3. Dee & Clwyd	20	10	30	60	20	80
4. Mersey & Weaver	70	40	110	245	65	310
5. Lancashire	40	10	50	100	30	130
6. Cumberland	35	20	55	60	50	110
Totals	315	110	425	955	245	1200

** Includes 10 m.g.d. for new Humberside conurbation.

*** Includes 100 m.g.d. for new Humberside conurbation.

10. It must be borne in mind that neither a Morecambe Bay nor a Solway Barrage could be ready in time to meet the demands for which other schemes are being prepared, notably Manchester's scheme to take water from Ullswater and Windermere, and the Tees Valley and Cleveland Water Board's proposed Cow Green reservoir in Upper Teesdale. Indeed, it seems likely that at least 200 m. g. d. of the 1981 deficiency will have to be met from inland sources because no barrage scheme could be ready in time. The potential demand for barrage water, therefore, may be about 225 m. g. d. in 1981 rising to perhaps 1000 m. g. d. by the turn of this century.

11. In considering barrages as possible sources of supply for the north of England it must be remembered that investigations are also proceeding into a Dee barrage and whilst a road crossing was the initial reason for these a considerable water yield might be obtained.

Possible patterns of distribution

12. The construction of one or more barrages would make it necessary to plan the distribution of water supplies over the whole of the north of England. A preliminary study reveals several possible patterns for this with far-reaching consequences for some of the problem areas hitherto considered in isolation. Water from a barrage at Morecambe Bay or Solway might be used to supply North East England, the West Riding and Humberside, as well as the nearer areas of Lancashire and Cumberland.

13. The best pattern of distribution will be determined by the quantity of water made available, the period of time which it is to serve and the costs of distribution. If the potential extra demand at the end of the century is of the order of 1000 m.g.d. (see paragraph 10 above) one barrage could not meet the whole need and additional supplies would be required later from a second barrage or elsewhere. This is not to imply that the demand should be met from barrages: the point is made solely to show the scale of development required in the event of it being found that adequate inland sources are not available or should not be used, or would be more expensive. Nor, on the other hand, should it be assumed at this stage that barrages would be an uneconomic investment especially if they could serve important ancillary purposes. Five theoretical patterns of distribution are shown in Figs. II - VI inclusive. They illustrate ways in which barrage schemes might be used to meet demands throughout the north of England.

Sequence of development

14. If barrages are to play a dominant part in meeting future demands in the north of England there is no doubt in our minds that on present information the Morecambe Bay project should have priority over Solway. There are two main reasons for this:-

(1) the largest deficiencies will arise in the area most economically supplied from Morecambe Bay;

(2) providing a large quantity of water south of the Lake District would make it possible to switch Lake District resources now used in Lancashire to meet growing demands in the Cumberland and Northumbrian river authority areas.

15. If Morecambe Bay were constructed first, Solway might then not be required until the last decade of this century unless large scale planned development were undertaken in the Solway area. If, however, there were substantial advantages apart from water supply in building the Solway barrage earlier, a decision to build it in addition to Morecambe would not add very materially to the overall capital cost of meeting demands in the whole of the north of England.

16. A decision on the Dee Barrage will be influenced only partly by the potential it affords for water conservation. If it were to be built, any water available for export from the Dee and Clwyd area might be more advantageously diverted to the Midlands.

Alternatives to barrages

17. The Technical Working Party are now collecting information about the resources other than the barrages which could be developed to meet future deficiencies. Schemes brought to their notice so far amount to some 1000 m. g. d. of which the greater part would be available independently of barrage yields. These schemes lie, in the main, in the areas of the Lancashire, Cumberland and Northumbrian river authorities. They include some 30 reservoirs of which about 10 are in National Parks. It is clear that there are likely to be objections from one interest or another to such schemes just as there are likely to be objections to the barrage schemes.

18. At this stage no firm figures of comparative monetary costs can be given. However, it seems that in south Lancashire and the West Riding the distributed cost of water from barrage schemes would not be much higher than from inland schemes; in other areas such as the Cumberland coast, north Lancashire and Tyneside the excess might be considerable.

Conclusions

19. The position is as follows:-

(1) without much more information on the matters discussed in paragraphs 4 to 7 above the feasibility or otherwise of barrages at either Morecambe Bay or Solway cannot be determined;

(2) until the Technical Working Party have completed their investigations we shall be unable to say how far inland resources can be expected to meet future demands. It is already clear, however, that an inland solution will involve highly controversial schemes;

(3) the information about yields and costs in the desk studies together with the Technical Working Party's work on future deficiencies show that barrages must be given serious consideration as major sources of supply for the north of England;

(4) for the reasons given in paragraph 14 namely proximity to the areas of deficiency and location south of the Lake District investigation of the Morecambe Bay project should, on water resources grounds, be put in hand first. Until a full feasibility study has been made it will not be possible to weigh the merits of a barrage solution as against an inland solution;

(5) even if such a study is put in hand immediately, however, we could not expect to complete a barrage scheme before 1977-79 ($3\frac{1}{2}$ years for feasibility study, 2 - 4 years for negotiating and obtaining statutory powers and for final design, 4 - 5 years for construction) and even this timetable allows nothing for the unexpected. Having regard to the large number of uncertainties about a project of this sort and its ramifications on a wide variety of authorities and interests, lengthy negotiations must be expected;

(6) for the above reason we shall have to rely on inland schemes to meet demands until the late 1970s. Decisions will, however, have to be taken in the early 1970s which will shape the pattern of development from about 1980 onwards. The choice of making a barrage scheme or schemes the basis of that pattern will not be open unless by then a full feasibility study of Morecambe Bay has been carried out. The Scottish Office point out that a feasibility study of the Solway scheme may well be required in the light of a programme for large scale growth in the area.

Reading Bridge House,
Reading,
Berkshire.

November 1966

APPENDIX A

WATER RESOURCES BOARD

Terms of Reference for studies of the Morecambe Bay and Solway Barrage Schemes

"To examine and report upon the following matters in respect of both Schemes:-

1. the feasibility and probable costs of construction;
2. the yields and qualities of water which would be made available;
3. the demand for water, and the rate of growth of that demand, in areas which might be supplied;
4. the arrangements necessary to distribute barrage water;
5. the delivered cost of treated or partially treated water;
6. other possible sources of supply in relation to the demand at 3. above and the costs of their staged development. "

Scope of the investigations to be carried out under each of paragraphs 1 - 6 of the Terms of Reference

1. The feasibility and probable costs of construction

After completion of surveys to determine possible locations and storage capacities at various top water levels and selection of locations for further investigations :-

(1) determination of geology and soil properties;

(2) consideration of the effects of ground conditions, purposes of the barrage and other factors on design;

(3) survey to locate sources of construction materials;

(4) preparation of preliminary designs and estimates;

(5) consideration of the effect of the barrage, with the aid of hydraulic models where necessary, on:-

  (a) land drainage and ground-water;
  (b) siltation in the lake;
  (c) siltation and coast erosion to seaward of the barrage;
  (d) tidal surge heights and wave action.

(6) consideration of the effect of the barrage on migratory fish and of ways and means of passing fish through the barrage;

(7) use of hydraulic models in preparing firm design features and construction methods including flood overflow;
(see also 2 (A) (2) below);

(8) estimates of the capital cost of:-

  (a) the barrage with and without provision for a public road across it;
  (b) consequential land drainage; coast protection and sewage disposal works;
  (c) service road links at both ends of the barrage;
  (d) compensation for extinction of rights and for losses;
  (e) prevention of siltation to seaward of the barrage (or, alternatively, capitalised cost of dredging).

2. The yields and qualities of water which would be made available

(A) Yield

  (1) determination of usable storage;
  (2) hydrological investigation of the contributing catchments;
  (3) analysis of (1) and (2) to determine reliable yield.

(B) Quality

- (4) programme of analyses of river waters under a variety of flow and seasonal conditions;
- (5) report on quality of stored water;
- (6) amenability of stored water to treatment at various water levels;
- (7) method of treatment.

3. The demand for water, and the rate of growth of that demand, in areas which might be supplied

(1) River authority areas to be investigated:-

- (a) Dee and Clwyd;
- (b) Mersey and Weaver;
- (c) Lancashire;
- (d) Cumberland;
- (e) Northumbrian;
- (f) Yorkshire Ouse and Hull.

(2) Size and rate of growth of water demand for:-

- (a) public supply;
- (b) industry other than agriculture;
- (c) agriculture;
- (d) electricity generation including cooling water.

4. The arrangements necessary to supply and distribute barrage water

(A) Supply

- (1) water abstraction;
- (2) water treatment;

(B) Distribution

- (3) pressure zones;
- (4) local storage arrangements;
- (5) trunk aqueduct systems;
- (6) local treatment installations;
- (7) connection to local supplies;
- (8) estimates of capital cost of works;

(9) estimates of operating costs of works.

5. The delivered cost of treated or partially treated water

(1) loan charges in respect of:-

- (a) headworks;
- (b) staged works;
- (c) distribution works;

(2) operating costs according to staged development;

(3) total unit cost of water treated and delivered.

6. Other possible sources of supply in relation to the demand at 3. above and the costs of their staged development

(1) areas to be examined - as at 3 (1);

(2) "conventional" sources:-

- (a) reservoirs -
  - (i) impounding;
  - (ii) pumped storage;
  - (iii) river regulating;
- (b) direct river abstraction;
- (c) water in underground strata;

(3) "other" sources:-

- (a) desalination;
- (b) re-charge of underground strata;

(4) in respect of each area investigations to arrive at the costs enumerated in 5 (1) - 5 (3) inclusive.

APPENDIX B

Summary of Sir Alexander Gibb and Partners' conclusions on their desk study of a Morecambe Bay Barrage Scheme

1. In their report the consultants stress that the following conclusions are "necessarily tentative...... new surveys will be required...... before the final location of the barrage can be selected...... before final estimates can be made careful sub surface investigations will be necessary...... Owing to the preliminary nature of the Desk Study and to allow for an adequate contingency factor we have given a low and high figure (of cost) for the major capital works to cover the best and worst conditions likely to be disclosed after full investigations...... Until this full scale study has been completed the feasibility or otherwise of the scheme cannot be finally determined".

2. Subject to the above remarks the consultants' conclusions are as follows :-

(a) The total run-off from the catchment area averages some 870 million gallons per day (45.76 cubic metres per second), the average of the 3 driest consecutive years being 695 m.g.d. (36.56 m^3/s).

(b) On the line selected for the barrage, with a top water retention level of +16 ft. (+4.88 m) O.D. and a draw down of 11 ft. (3.35 m) the available storage capacity of the reservoir would be approximately 55000 million gallons ($249\ 10^6\ m^3$), enabling a supply of the order of 500 m.g.d. (26.30 m^3/s) to be provided after making appropriate allowances for losses.

(c) An embankment dam can be constructed across Morecambe Bay for a sum of between £28 and £35 million in 4 to 5 years from a contract being placed. This amount includes for a dual two-lane highway and for the necessary revetment of existing flood banks around the perimeter of the reservoir. The additional cost of the water treatment works would be between £26 and £34 million for a 500 m.g.d. supply (26.30 m^3/s).

(d) For a full barrage development with a total supply of 500 m.g.d. (26.30 m^3/s) the cost of fully treated water would lie between a "low" of 6.7 and a "high" of 8.4 pence per thousand gallons; for the same development but with treatment works limited initially to 100 m.g.d. (5.26 m^3/s), the corresponding costs would lie between 18.6 and 23.3 pence per thousand gallons. For partially treated water these costs would be reduced by some 10% for 100 m.g.d. (5.28 m^3/s) and 25% for 500 m.g.d. (26.30 m^3/s). For untreated water the reductions would be about 20% and 50% respectively.

(e) The cost per thousand gallons for up to 300 m.g.d. (15.78 m^3/s) is high and the consultants have therefore considered a staged development; Stage I being the eastern half of the barrage, i.e. an embankment dam between Hest Bank and a point south of Humphrey Head with a temporary connection to the latter. The run-off from the River Kent catchment would yield up to 250 m.g.d. (13.15 m^3/s). The capital cost for the embankment dam and associated works would be between £13 and £20 million. This figure does not allow for a dual two-lane carriageway which could be constructed later.

The additional cost of water treatment works would be between £13 and £17 million for a 250 m.g.d. (13.15 m^3/s) supply.

In the case of a staged barrage development with first stage giving 250 m.g.d. (13.15 m^3/s), the cost of treated water would lie between a "low" of 6.7 and a "high" of 9.0 pence per thousand gallons; for the same development, but with treatment works limited initially to 100 m.g.d. (5.26 m^3/s), the corresponding costs would lie between 11.1 and 15.5 pence per thousand gallons. The percentage reductions for partially treated and untreated water would be of the same order as stated above.

(f) It would appear that if a demand of 300 to 500 m.g.d. (15.78 to 26.30 m^3/s) can be foreseen a full-scale study should be undertaken to determine the feasibility or otherwise of the scheme.

(g) The decision to construct the embankment dam as a whole or to proceed on the basis of a staged development may well depend not only on the foreseeable demand for water, but also on the economic advantages of a trunk road across the bay. This cannot be assessed until the results of a traffic study are available.

(h) The consultants have included in their estimate sums to cover such supplementary costs as the drainage and maintenance of existing agricultural lands protected by flood banks; for reservoir management and maintenance; for the costs of maintaining fisheries, and the technical investigations and engineering studies necessary to implement the project. The estimates include engineering charges, interest during construction at 7%, administration, site supervision and construction models, but do not allow for department administration charges or for the acquisition of land, including the area of the bay itself, or for legal expenses.

(i) Considerable areas of shallow water will exist in the reservoir and the consultants recommend these should be reclaimed and brought into use for agriculture; some 15,000 acres (60 km^2) are involved. If this is not done, as the water level ranges from normal to low, large areas of unpleasant mud or rotting vegetation could be exposed. Apart from possible water treatment problems the elimination of these areas will be desirable from the aspect of amenities.

APPENDIX C

Summary of Messrs. Babtie, Shaw and Morton's conclusions on their desk study of a Solway Barrage Scheme

The conclusions below are preceded by the following remarks by the consultants "The present study is of course merely a first step towards a full feasibility study which would be based on information obtained from detailed site surveys, exploratory borings and model investigations. Meantime, in the absence of such precise data, some of our conclusions are necessarily tentative". With that overriding qualification the consultants summarise the findings of the desk study as follows :-

1. A barrage across the Solway is considered to be practicable and to have potentialities justifying the institution of a comprehensive feasibility study.

2. At the most favourable barrage site the size of reservoir which can be formed to provide balancing storage is small in relation to the run-off from the extensive catchment. This gives rise to problems of flood control, siltation and variations in water quality all of which could, however, be overcome by reasonable means. As a result a practical scheme could be developed to produce large quantities of water at low cost.

3. In a first stage of development a supply of 380 million gallons per day could be made available. This could be increased in a second stage to 465 m.g.d. and in an ultimate third stage to 585 m.g.d.

4. Water of good potable standard could be produced by means of filtration plant of the type normally used to treat impounded surface waters. Because of the large volume of supply, the cost of the treatment provisions would represent the greater part - up to 75% - of the total capital expenditure involved in the scheme.

5. The first stage of development for 380 m.g.d. would entail capital expenditure of £29 million, of which £8 million would be in respect of the barrage structure. The overall cost would be £34 million for the second stage yield of 465 m.g.d. and £42 million for the ultimate yield of 585 m.g.d.

6. If the capacity of the draw-off and treatment works were limited in the first instance to 100 m.g.d., the initial capital cost would be £13 million.

7. Taking account of loan charges and running costs, and basing on the full yields, the unit costs in pence per 1000 gallons of treated water provided in tanks 35 feet above sea level would be 5.29d. for the first stage, 5.65d. for the second, and 5.00d. for the third. The unit cost of the first 100 m.g.d. of treated water would be 8.35d. per 1000 gallons.

8. Untreated water could be delivered to tanks 50 feet above sea level at unit costs of 1.62d. per 1000 gallons for a supply of 380 m.g.d. and of 4.40d. per 1000 gallons for the first 100 m.g.d.

9. Rockcliffe and Burgh Marshes at the head of the firth are the main areas

of land bordering the reservoir where present use would be directly affected, particularly by the works envisaged in the second and third stages of development.

10. The important river and coastal fisheries of the Solway would probably be adversely affected for a period following the construction of a barrage. It would nevertheless appear that with the provision of facilities to ensure the passage of migratory fish through the barrage, any long term effects would not be serious.

11. The barrage, in addition to its primary function of creating a source of water supply, could convey certain incidental benefits. The freshwater lake with an area of some 16 square miles could enhance the amenities of the district and give scope for fishing, sailing and other recreational activities. The barrage itself would provide the opportunity for improving road communication between Scotland and North-West England. In carrying out dredging to counteract siltation in the reservoir, certain areas of marsh and foreshore could in time be reclaimed and turned to agricultural or other use.

12. As regards the time required for development, if allowance be made for the feasibility study, for the negotiation of the administrative and financial arrangements, for the acquisition of the necessary statutory powers and for the design and construction of the works, it is apparent that an overall period of 11 to 12 years would be taken up in bringing the scheme to fruition.

Printed in England for Her Majesty's Stationery Office
by Direct Design Products.

Dd. 129236 K12 11/66

WATER RESOURCES BOARD

MORECAMBE BAY AND SOLWAY BARRAGES

Report on Desk Studies

London: Her Majesty's Stationery Office
1966

Water Resources Board Publication No. 4